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An optical disk drive, and a method of assembling it

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An optical disk drive, and a method of assembling it

EPO - DG 1

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(54)

The invention relates to an optical disk drive according to the preamble of claim 1.

In the prior art, an optical disk drive generally comprises an optical pick-up unit, a linear guide, a sub-frame, a spring mounted frame and a disk drive motor. Signals to  
5 and from the optical pick-up unit are transmitted to and from a printed circuit board (PCB) through a so-called FLEX connection. This connection conducts read, write, servo and power signals. The amplitudes and sensitivities of these signals are very different. This leads to cross talk problems of these signals.

Furthermore, the optical pick-up unit is normally produced in a separate  
10 production site. If an optical pick-up unit is built into the optical disk drive in an another production line, assembly tolerances are added to the production tolerances of an optical pick-up unit. This results in a non-negligible percentage of rejects in the production, once after production of the pick unit and once after assembly of the drive. In principle, production tolerances and assembly tolerances can compensate for each other, but due to the testing after  
15 production of the pick-up unit this compensation can not be used since pick-up units will be rejected before compensation can take place.

An embodiment of an optical disk drive according to the preamble of the claim 1 is for example known from US-A-5,214,630. The optical pick-up unit is split into a fixed part containing the light source and a movable part containing at least a mirror, focusing lens  
20 and lens moving elements. The size and weight of the movable part is therewith reduced substantially so that response times can be reduced as well. Also the flexible signal connection can be simplified.

An object of the present invention is to further improve the optical disk drive of the type referred to in the preamble.

25 The optical disk drive according to the invention is characterised by the features of the characterising portion of claim 1.

Due to the presence of only one PCB onto which the components are mounted, there is no need for many connectors that increases the reliability. The connection to the lens moving means of the pick-up unit remains but these are no sensitive connections. Due to the

integration of the optical pick-up unit in the production and assembly process, only one final test is necessary which will reduce the percentage of rejects and will simplify test procedures.

Preferably, the PCB includes electronic components that are mounted to the PCB on a side thereof facing an adjacent housing wall.

5           Due to the arrangement of the electronic components on a side opposite from the other components, or in other words on the side facing the adjacent housing wall, the heat of the electronic components is kept away from the optical pick-up unit thereby improving reliability and accuracy. Furthermore it is easier to remove this heat from the drive unit by conduction such that it may obviate the need for a cooling fan. If such cooling fan is not used  
10 then also an air filter is not necessary anymore. This reduces the cost and creates possibilities for further miniaturisation. A further improvement of the removal of heat from the housing is obtained if the PCB is mounted to the housing through heat conducting mounting means, such as a heat- conducting mat.

          An embodiment of the disk drive in which the housing is made of metal not  
15 only improves the heat conducting properties even more, but also improves the EMC shielding. Due to the better heat removal there is no need for large cooling openings in the housing wall, which further improves the shielding effect, both for radiation into and out of the housing.

          According to a preferred embodiment, the flexible wires are contained within  
20 a wire flex which is bendable around one bending axis only, said bending axis being substantially parallel to the shaft of the drive motor.

          Due to this arrangement of the wire flex it can be kept away from components which are sensitive to EMC or electrical radiation. It is also enables a flatter design of the disk drive.

25           It is preferred to mount a linear guide for the movable part of the optical pick-up unit directly on the PCB. This greatly simplifies the design. It is made possible due to critical parts being more rigidly mounted on the PCB. The heat- conducting mat, if any, will reduce vibrations if shocks occur. A plastic mat will also serve as mechanical filter for high frequencies. The use of a fixed part and movable part for the pick-up unit will reduce the  
30 mass of the components around the moving lens enabling the increase of servo bandwidth.

          The invention also relates to a method of assembling an optical disk drive, comprising the steps of providing a housing, a drive motor and drive shaft to be mounted within the housing and adapted to engage the disk for rotating it, an optical pick-up unit, including a light source, at least a mirror and a focussing lens to create a focussed beam, a

guide for moving the focussed beam along the disk, and a print board connected to the guide through flexible wires.

According to the invention first the main electrical components are mounted on one side of the PCB, and then the slide, the pick-up unit, and the drive motor are mounted  
5 on the opposite side of the PCB.

This will simplify the assembly of the disk drive unit since it is not necessary anymore to turn around the PCB. It further reduces assembly tolerances since all mechanical and optical parts are mounted from one side.

The invention will be explained in more detail with reference to the drawings  
10 showing an exemplary embodiment of the optical disk drive according to the invention in a very schematic way.

Fig. 1 is a very schematic sectional side view of an optical disk drive according to the invention.

Fig. 2 is a very schematic plan view according to the lines II-II in Fig. 1.

15 The drawing very schematically shows an optical disk drive for reading and or writing an optical disk D. The optical may be of any type, for example CD, CD-ROM, DVD or the like, which are readable or writable. The optical disk drive is thus for recording and/or reproducing information on the information track of the optical disk D.

The optical disk drive comprises a housing, very schematically indicated with  
20 reference numeral 1, for accommodating components of the disk drive. Preferably, the housing 1 is made of metal. The housing 1 has a closable opening (not shown) for introducing and removing the disk D into and out of the disk drive.

Within the housing 1 there is mounted a drive motor 2 having a drive shaft 3 and a hub 4 for receiving the disk D thereon in order to allow the disk D to be rotated by the  
25 drive motor 2.

The housing 1 further contains an optical pick-up unit (OPU) 5 adapted to read information from or write information on the optical disk D by means of a focused light beam 6. According to the invention, the optical pick-up unit 5 includes a fixed part 7 and a movable part 8. The fixed part 7 is stationary mounted, whereas the movable part 8 is movable such as  
30 to move the focused light beam 6 along the surface part of the disk D containing information. In the case as shown, the movable part 8 is movable in radial direction with respect to the disk D by means of a linear guide 9 including guide rails 10 and supports 11.

The fixed part 7 of the optical pick unit 5 includes means to produce the light beam 6, such as a (laser) light source and peripherals. It also comprises means to receive the

beam of light reflected from the disk D. The output signal of the receiving means is used for reproducing the information on the disk D and also for controlling the focused beam 6.

The movable part 8 of the optical pick-up unit 5 includes a mirror 13 for reflecting the light beam 6 and the reflected light beam through  $45^{\circ}$  and further includes a focusing lens 14 and actuator means (not shown) in order to move the lens 14 to properly direct and focus the beam 6 on the optical disk D.

In order to move the movable part 8 along the linear guide 9 i.e. as a slide along the guide rails 10, there is provided a micro stepping motor 15 operatively connected to the movable part 8 through a screw spindle 16. Of course, other driving and transmission means are conceivable.

As is clearly shown in Fig. 1, the drive motor 2, the fixed part 7 of the optical pick-up unit 5 and the supports 11 of the linear guide 9 of the movable part 8 of the optical pick-up unit 5 are mounted on a single printed circuit board (PCB) 17. Thus, the printed circuit board 17 not only contains electronic components and connections to provide for the electronic control, but also forms a mounting base for the main parts of the disk drive unit. Also the stepping motor 15 is mounted on PCB 17.

The main electronic components 18 of the PCB 17 are mounted on the side of the PCB 17 facing the adjacent wall of the housing 1, i.e. opposite to the optical means and the drive means for the disk D. The heat of these electronic components can be dissipated by a heat conducting (plastic) mat 19 onto which PCB is mounted. Through this mat 19 and the metal wall of the housing 1, the heat can be effectively removed from the interior of the disk drive.

The PCB 17 and the lens actuators on the movable part 8 of the optical pick-up unit 5 are electrically and electronically connected through flexible wires combined in a wire flex 20. This wire flex 20 is flexible in one direction only and according to the invention the wire flex 20 is bendable around an axis substantially parallel to the drive shaft 3 of the drive motor 2 as is shown in Fig. 2. The wire flex 20 may be very simple and may contain as much as four wires which conduct signals of similar magnitudes thereby reducing or preventing cross talk problems.

Assembly of the PCB 17 and components is as follows. First of all, electronic components 18 are mounted to the lower side of the PCB 17. Then the drive motor, the supports 11 with guide rails 10 and movable part 8 and the fixed part 7 are mounted on the upper side of the PCB 17. Finally there is one soldering step in which all connections between the components and the PCB 17 are made. Due to this way of assembling, it is not

necessary to turn around the PCB 17 during production, whereas the addition of tolerances and lay-up tolerances are prevented. It requires only one final measurement for testing.

From the foregoing it will be clear that the invention provides an optical disk drive which is simple, reliable and robust, and which has a high performance and a longer  
5 lifetime. The method of assembling the optical disk drive leads to a lower percentage of rejects.

The invention is not restricted to the above-described embodiment as shown in the drawing, which can be varied in several ways without departing from the scope of the invention.

## CLAIMS:

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16. 08. 2002

(54)

1. An optical disk drive, comprising:  
a housing;

a drive motor and drive shaft mounted within the housing and adapted to engage the disk for rotating it,

5 an optical pick-up unit, including a fixed part containing at least a light source, and a movable part slidably mounted on a guide and containing at least mirror, a focusing lens and lens moving elements, said movable part being adapted to move a focussed beam along the disk,

a PCB including a signal connection to the lens moving elements on the  
10 movable part of the pick-up unit through flexible wires,  
characterized in that

only one PCB is provided which serves as a mounting base for the fixed part of the optical pick-up unit, the guide and the drive motor.

15 2. The optical disk drive as claimed in claim 1, wherein the PCB includes electronic components which are mounted to the PCB on a side thereof facing an adjacent housing wall.

3. The optical disk drive as claimed in claim 1 or 2, wherein the PCB is mounted  
20 to the housing through heat conducting mounting means, such as a heat conducting mat.

4. The optical disk drive as claimed in claim 1, wherein the flexible wires are contained within a wire flex which is bendable around one bending axis only, said bending axis being substantially parallel to the shaft of the drive motor.  
25

5. The optical disk drive as claimed in any of the preceding claims, wherein the linear guide for the movable part of the optical pick-up unit is mounted directly on the PCB.



6. The optical disk drive as claimed in any of the preceding claims, wherein the housing is made of metal.

7. The optical disk drive as claimed in any of the preceding claims, wherein the  
5 movable part of the pick-up unit includes an actuator comprising driving coils for the focusing lens, said driving coils being connected to the PCB through said flexible wires.

8. A method of assembling an optical disk drive, comprising the steps of:  
providing a housing; a drive motor and drive shaft to be mounted within the  
10 housing and adapted to engage the disk for rotating it, an optical pick-up unit, including a light source, at least a mirror and a focussing lens to create a focussed beam, a guide for moving the focussed beam along the disk, and a PCB having main electrical components and being connected to the guide through flexible wires,  
characterized in that

15 first the main electrical components are mounted on one side of the PCB, and then the guide, the pick-up unit, and the drive motor are mounted on the opposite side of the PCB.

9. The method as claimed in claim 8, wherein the parts and electrical components  
20 are fixed to the PCB in one soldering step.

## ABSTRACT:

An optical disk drive comprises an optical pick-up unit (5), including a fixed part (7) containing at least a light source, and a movable part (8) mounted on a guide (9) and containing at least a mirror (13), a focusing lens (14) and lens moving elements. The movable part is adapted to move a focussed beam along the disk (D). A PCB (17) includes a signal  
5 connection to the lens moving elements on the movable part of the pick-up unit through flexible wires (20).

Only one PCB (17) is provided which serves as a mounting base for the fixed part (7) of the optical pick-up unit (5), the guide (9) and the drive motor (2).

10 Fig. 1

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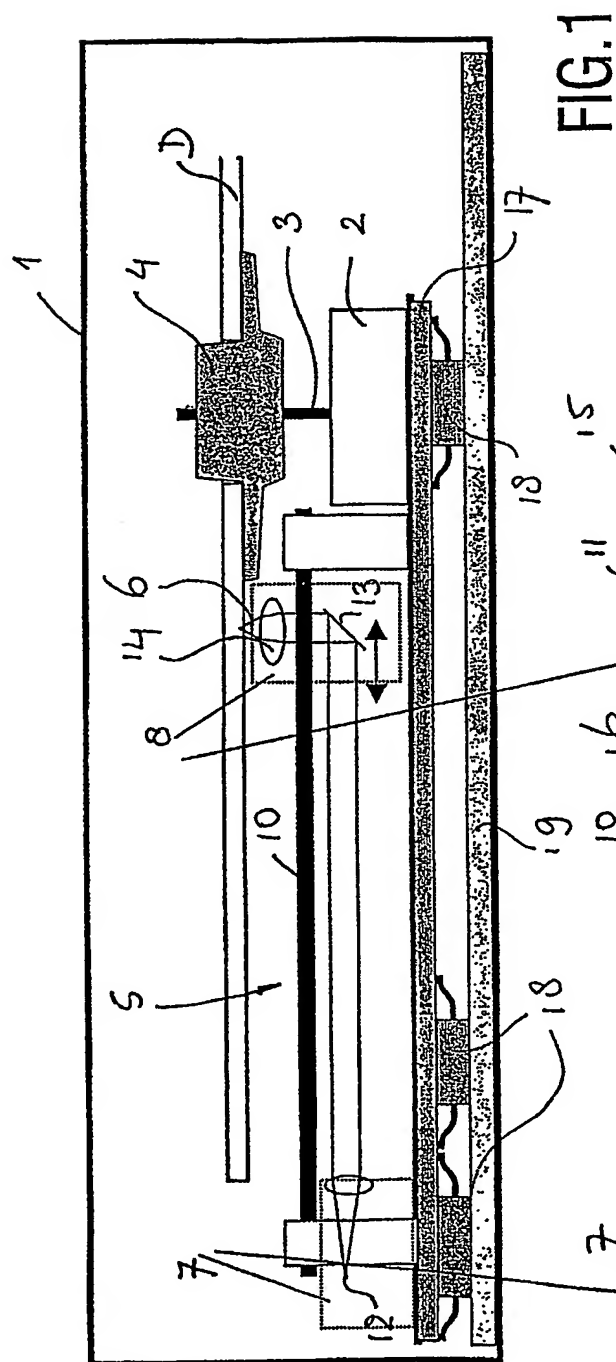


FIG. 1

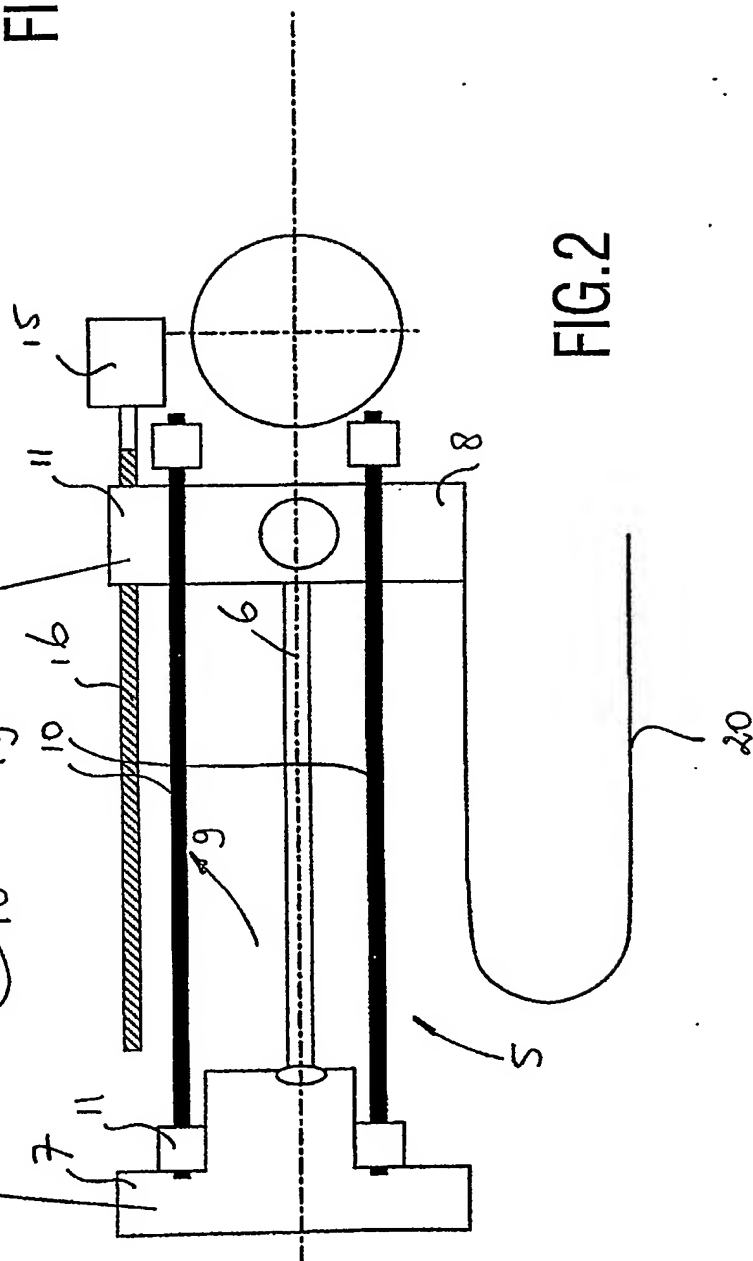


FIG. 2